

**WHAT IS CLAIMED IS:**

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1. A floating-point unit (FPU) configurable to perform floating-point operations, comprising:  
an operand processing section operative to, for each floating-point operation, receive and process one or more input operands to provide a preliminary result;  
and  
an operand flush section coupled to the operand processing section and operative to  
determine whether the preliminary result falls within one of a plurality of ranges of values, and  
set the preliminary result to one of a plurality of set values if the preliminary result falls within one of the plurality of ranges of values.

2. The FPU of claim 1, wherein the operand flush section is operative to set the preliminary result to one of two set values if it falls within one of two ranges of values.

3. The FPU of claim 2, wherein a first range of values includes values greater than zero and less than half of a minimum normalized floating-point number, or  $0 < y < a_{\min}/2$ , and wherein a second range of values includes values equal to or greater than half of the minimum normalized floating-point number and less than the minimum normalized floating-point number, or  $a_{\min}/2 \leq y < a_{\min}$ .

4. The FPU of claim 3, wherein the preliminary result is set to zero if it falls within the first range of values and to the minimum normalized floating-point number,  $a_{\min}$ , if it falls within the second range of values.

5. The FPU of claim 1, wherein the plurality of ranges are selected such that a determination of whether the preliminary result falls within one of the ranges can be performed by checking an exponent of the preliminary result.

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1 6. The FPU of claim 1, wherein the plurality of ranges are defined by a set  
2 of threshold values that are related by factors of two.

1 7. The FPU of claim 1, wherein the plurality of ranges cover  
2 denormalized floating-point numbers between zero and a minimum normalized floating-  
3 point number,  $a_{\min}$ .

1 8. The FPU of claim 1, and operable to perform a reciprocal operation.

1 9. A floating-point unit (FPU) configurable to perform floating-point  
2 operations, comprising:

3 a mantissa processing section operative to, for each floating-point  
4 operation,

5 receive and process one or more mantissas for one or more input  
6 operands to provide a preliminary result mantissa,

7 set the preliminary result mantissa to a first mantissa value if a  
8 result of a floating-point operation is within a first range of values, and

9 set the preliminary result mantissa to a second mantissa value if the  
10 result is within a second range of values; and

11 an exponent processing section coupled to the mantissa processing unit  
12 and operative to

13 receive and process one or more exponents for the one or more  
14 input operands to provide a preliminary result exponent,

15 set the preliminary result exponent to a first exponent value if the  
16 result is within the first range of values, and

17 set the preliminary result exponent to a second exponent value if  
18 the result is within the second range of values.

1 10. The FPU of claim 9, wherein

2 the first range of values includes values greater than zero and less than a

3 first threshold value defined as half of a minimum normalized floating-point number, or 0

4  $< y < a_{\min}/2$ , and

5 *Sub*  
6 *03* the second range of values includes values equal to or greater than the first  
7 threshold value and less than a second threshold value defined as the minimum  
normalized floating-point number, or  $a_{\min}/2 \leq y < a_{\min}$ .

1 11. The FPU of claim 9, wherein combination of the first mantissa and  
2 exponent values represents zero, and wherein the combination of the second mantissa and  
3 exponent values represents the minimum normalized floating-point number,  $a_{\min}$ .

1 12. The FPU of claim 9, wherein a determination of whether the result is  
2 within the first or second range of values is performed by checking the preliminary result  
3 exponent.

1 13. A floating-point unit (FPU) configurable to perform floating-point  
2 operations, comprising:

3 a mantissa processing section operative to, for each floating-point  
4 operation,

5 receive and process one or more mantissas for one or more input  
6 operands to provide a preliminary result mantissa, and

7 set the preliminary result mantissa to one of a plurality of possible  
8 mantissa values if a result of a floating-point operation falls within one of a  
9 plurality of ranges of values; and

10 an exponent processing section coupled to the mantissa processing unit  
11 and operative to

12 receive and process one or more exponents for the one or more  
13 input operands to provide a preliminary result exponent, and

14 set the preliminary result exponent to one of a plurality of possible  
15 exponent values if the result falls within one of the plurality of ranges of values.

1 14. The FPU of claim 13, wherein the preliminary result mantissa and the  
2 preliminary result exponent are each set to one of two possible values depending on  
3 whether the result falls within one of two ranges of values.

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2 *0030* 15. The FPU of claim 13, wherein the plurality of ranges of values are  
3 selected such that a determination on whether the result falls within one of the ranges can  
4 be made by checking the preliminary result exponent against one or more exponent  
comparison values.

1 16. A floating-point unit (FPU) configurable to perform arithmetic  
2 operations, comprising:  
3 an exponent processing unit operative to receive and process one or more  
4 exponents for one or more input operands for each arithmetic operation to provide a  
5 preliminary result exponent partially indicative of a result of an arithmetic operation; and  
6 an exponent flush unit coupled to the exponent processing unit, the  
7 exponent flush unit operative to  
8 receive and compare the preliminary result exponent to at least one  
9 exponent comparison value, and  
10 set the preliminary result exponent to one of a set of possible  
11 exponent set values based on results of the comparison between the preliminary  
12 result exponent and the at least one exponent comparison value.

1 17. The FPU of claim 16, wherein the preliminary result exponent is  
2 compared to one exponent comparison value,  $E_{\min} - 1$ , that is equal to one less than an  
3 exponent value,  $E_{\min}$ , for a minimum normalized floating-point number.

1 18. The FPU of claim 17, wherein the preliminary result exponent is set to  
2  $E_{\min}$  if it is equal to the exponent comparison value of  $E_{\min} - 1$ .

1 19. The FPU of claim 17, wherein the preliminary result exponent is set to  
2 an exponent value for zero if it is less than the exponent comparison value of  $E_{\min} - 1$ .

1 20. A floating-point processor comprising:  
2 a memory unit operative to store instructions;  
3 an instruction dispatch unit operative to retrieve instructions from the  
4 memory unit; and  
5 a floating-point unit (FPU) coupled to the instruction dispatch unit and  
6 operative to perform a floating-point operation on one or more input operands to provide

PA 7  
8 a preliminary result, wherein the preliminary result is flushed to zero if it falls within a first range of values and set to a set value if it falls within a second range of values.

1 21. The floating-point processor of claim 20, wherein  
2 the first range of values includes values greater than zero and less than half  
3 of a minimum normalized floating-point number, or  $0 < y < a_{\min}/2$ , and  
4 the second range of values includes values equal to or greater than half of  
5 the minimum normalized floating-point number and less than the minimum normalized  
6 floating-point number, or  $a_{\min}/2 \leq y < a_{\min}$ .

1 22. The floating-point processor of claim 20, wherein a determination on  
2 whether the preliminary result falls within the first or second range of values is made by  
3 checking an exponent of the preliminary result.

1 23. A method for performing a floating-point operation, comprising:  
2 receiving one or more input operands for the floating-point operation;  
3 processing the one or more received operands to provide a preliminary  
4 result;  
5 determining whether the preliminary result is within a first or second range  
6 of values;  
7 setting the preliminary result to a first value if it is within the first range of  
8 values; and  
9 setting the preliminary result to a second value if it is within the second  
10 range of values.

1 24. The method of claim 23, further comprising:  
2 checking an exponent of the preliminary result to determine whether the  
3 preliminary result falls within the first or second range of values.

1 25. The method of claim 23, wherein the first value is zero and the second  
2 value is a minimum normalized floating-point number.

1 26. The method of claim 23, wherein

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3 *az* the first range of values includes values greater than zero and less than half  
4 of a minimum normalized floating-point number, and

5 the second range of values includes values equal to or greater than half of  
6 the minimum normalized floating-point number and less than the minimum normalized  
floating-point number.

1 27. A computer program product for performing a floating-point  
2 operation, comprising:

3 code that directs reception of one or more input operands for the floating-  
4 point operation;

5 code that processes the one or more received operands to provide a  
6 preliminary result;

7 code that determines whether the preliminary result is within a first or  
8 second range of values;

9 code that sets the preliminary result to a first value if it is within the first  
10 range of values;

11 code that sets the preliminary result to a second value if it is within the  
12 second range of values; and

13 a data storage medium operative to store the codes

1 28. The computer program product of claim 27, further comprising:

2 code that checks an exponent of the preliminary result to determine  
3 whether the preliminary result falls within the first or second range of values.

1 29. The computer program product of claim 27, wherein

2 the first range of values includes values greater than zero and less than half  
3 of a minimum normalized floating-point number,

4 the second range of values includes values equal to or greater than half of  
5 the minimum normalized floating-point number and less than the minimum normalized  
6 floating-point number,

7 the first value is zero, and

8 the second value is the minimum normalized floating-point number.

1 30. An article of manufacture comprising:

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computer-readable program code that causes a computer to describe an operand processing section, wherein the operand processing section is operative to, for each floating-point operation, receive and process one or more input operands to provide a preliminary result;

computer-readable program code that causes a computer to describe an operand flush section, wherein the operand flush section is coupled to the operand processing section and operative to determine whether the preliminary result falls within one of a plurality of ranges of values, and to set the preliminary result to one of a plurality of set values if the preliminary result falls within one of the plurality of ranges; and

a computer-usable medium configured to store the computer-readable program codes.

31. An article of manufacture comprising:

computer-readable program code that causes a computer to describe a memory unit, wherein the memory unit is operative to store instructions;

computer-readable program code that causes a computer to describe an instruction dispatch unit, wherein the instruction dispatch unit is operative to retrieve instructions from the memory unit;

computer-readable program code that causes a computer to describe a floating-point unit (FPU), wherein the FPU couples to the instruction dispatch unit and is operative to perform a floating-point operation on one or more input operands to provide a preliminary result, wherein the preliminary result is flushed to zero if it falls within a first range of values and set to a set value if it falls within a second range of values; and

a computer-usable medium configured to store the computer-readable program codes.

32. A computer data signal embodied in a transmission medium comprising:

computer-readable program code that causes a computer to describe an operand processing section, wherein the operand processing section is operative to, for each floating-point operation, receive and process one or more input operands to provide a preliminary result; and

computer-readable program code that causes a computer to describe an operand flush section, wherein the operand flush section is coupled to the operand

$\frac{1}{\sqrt{\pi}} \int_{-\infty}^{\infty} f(x) e^{-x^2} dx = \frac{1}{\sqrt{\pi}} \int_{-\infty}^{\infty} f(x) e^{-x^2} dx$